Memorandum

U.S. Department
of Transportation
Federal Aviation
Administration

Subject: INFORMATION: Side-Facing Seats on Transport Category Airplanes

Date: November 19, 1997

From: Manager, Transport Airplane Directorate, Aircraft Certification Service, ANM-100

Reply to Attn. of:

To: SEE DISTRIBUTION

This memorandum provides dynamic test requirements and pass/fail criteria for side-facing seats on Transport Category Airplanes. Attached is guidance material, in the form of draft generic issue papers, pertaining to side-facing accommodations. Single occupancy and multiple occupancy ("divans") installations are treated separately, since there are separate approaches to each. These drafts can be used to develop project-specific issue papers.

Amendment 25-64, which adopted § 25.562, provides a means of enhancing occupant protection under more realistic conditions than had previously existed. The requirements contained therein consist of both test conditions and pass/fail criteria.

The dynamic test conditions, in terms of both pulse severity and types of tests currently required, are also considered to be directly applicable to side-facing seats. While it is true that the regulation was written with forward- and aft-facing seats in mind, the orientation of the seat does not change the relevant test conditions, and the rule applies to all seats.

For pass/fail criteria, however, the orientation of the seat may be significant. Injury criteria are currently limited to head, spine, and femur loads. Head injury is evaluated for contact experienced by the head against any aircraft interior installations, and the pass/fail criterion is based on the resultant head acceleration considering all axes of head motion. The lumbar spinal load is an axially compressive load that is primarily evaluated during the 14g, 60° test. The femur load is also compressive, and actually has not proved to be critical thus far. For a side-facing seat, other injury parameters may predominate such that evaluation of those parameters may be necessary to provide an acceptable level of safety.

The first consideration for a side-facing seat is the isolation of one occupant from another. That is, occupants should not rely on the impact with other occupants to provide energy absorption; body-to-body impacts as discussed in the attachment are considered unacceptable. The second consideration is the retention of occupants in the seat and restraint system. Addressing this concern may necessitate

providing a means of restraint for the lower limbs as well as the torso. Failure to limit the forward (in the airplane's coordinate system) travel of the lower limbs may cause the occupant to come out of the restraint system or produce severe injuries due to the resulting position of the restraint system and/or twisting (torsional load) of the lower lumber spinal column.

A third consideration is limiting the load in the torso in the lateral direction, where human tolerance differs from that for the forward or aft facing directions and other potential injury mechanisms exist. The automotive industry has developed test procedures and occupant injury criteria appropriate for side impact conditions. Their criteria involves limitation of lateral pelvic accelerations, and use of the human tolerance parameter "Thoracic Trauma Index," which is defined in 49 CFR § 571.214. Use of the 49 CFR § Part 572, Subpart F, Side Impact Dummy (SID), rather than the 49 CFR § Part 572, Subpart B, Hybrid II dummy used in the current § 25.562, test is required to evaluate these parameters. This is the best means available at present to assess the injury potential of a sideward impact condition. Such an evaluation is considered necessary to provide an acceptable level of safety for these types of seats.

Other potential injury mechanisms appropriate for aircraft seats may exist. However due to the lack of useful injury criteria for those other potential injury parameters, such as neck loads and lower limb flail, we are not able to specify criteria applicable to those areas at this time. We believe that such criteria may be appropriate, particularly for multiple occupancy installations, however, and intend to pursue their further development.

For single occupancy seats, the criteria provided in the associated attached issue paper have been determined to result in a level of safety equivalent to that provided by the pass/fail criteria in § 25.562 for forward or aft-facing seats. Accordingly, the certification of single occupancy side-facing seats intended to be installed to these criteria should be documented with a special condition in accordance with the provisions and requirements of § 21.16. We recognize that there have been approvals in accordance with § 25.562 that may not match these criteria exactly. While those approvals are still considered valid, any new approvals should use as their initial position the criteria provided here. As experienced is gained and additional data are developed, we expect that these criteria will evolve.

For multiple occupancy seating, the best criteria currently available cannot be said to provide an equivalent level of safety for those occupants. Therefore, the only means available for accepting these installations would be through an exemption from the general occupant protection requirements of § 25.785(b). In this case, the associated attached issue paper summarizes criteria that are currently available, and could form the basis for inclusion in a petition for exemption from the noted requirement if an applicant so chooses. Any petition for exemption must also, of course, address why a grant of the petition would be in the public interest, in accordance with § 11.25(b)(5). We would like to stress that a grant of exemption is not automatic, and the applicant must address to the satisfaction of the FAA, why installing multiple occupancy, side-facing seating, in lieu of forward or aft-facing seating with a higher level of safety, is in the public interest.

We intend to continue to refine the compliance criteria for multiple occupancy seating with the goal of establishing an equivalent level of safety and we expect industry to assist in this effort. In the event those criteria may be established, this memorandum will be updated accordingly and the certification of multiple occupancy side-facing seating may then be processed with special conditions in lieu of

exemptions. We anticipate that any designs approved under the terms of an exemption in the interim would retain their approval, although each exemption request will be treated individually. Any subsequent designs would be required to comply with the criteria developed, regardless of whether they were intended for installation on the same airplanes.

Any questions may be directed to Jeff Gardlin, telephone 425-227-2136.

Original signed by S.R. Miller for

Ronald T. Wojnar

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ISSUE PAPER

PROJECT: Generic

ITEM: CI-1
STAGE: 2

REG. REF.: §§ 11.25, 25.562, 25.785

DATE: Nov. 12, 1997

NATIONAL POLICY REF.:

ISSUE STATUS: OPEN

SUBJECT: Dynamic Test Requirements for Side-Facing Divans (Sofas)

BRANCH ACTION: ANM-112, AAM-630, ANM-102N

Please read 11/19/97 memo Based on GIP # C-x1

COMPLIANCE TARGET: Pre-TC

PETITION FOR EXEMPTION

STATEMENT OF ISSUE: Side Facing seats are considered a novel design for Transport Category Airplanes that include amendment 25-64 in the certification basis, and were not considered when those airworthiness standards were promulgated. The FAA has determined that the existing regulations do not provide adequate or appropriate safety standards for occupants of side-facing multiple occupant seats (divans). Additionally, the best criteria currently available for evaluation of this type of seating do not ensure a level of safety that is equivalent to that afforded to occupants of forward and aft facing seating. Therefore, the only certification method available for this type of seating, for aircraft that include Amendment 25-64 in their certification basis, is through an exemption from the general injury requirements of 25.785(b).

This issue paper will be used to establish the minimum acceptable testing and human injury criteria that will be applied to side-facing divan certifications. This information will complement the exemption process as defined in 14 CFR Part 11.25 and in no way is intended to circumvent the need to provide an acceptable public interest argument as required per §11.25 (b)(5).

BACKGROUND: Part 25 of the Federal Aviation Regulations (FAR) was amended June 16, 1988, by Amendment 25-64, to revise the emergency landing conditions that must be considered in the design of the airplane. Amendment 25-64 revised the static load conditions in § 25.561, and added a new § 25.562 that required dynamic testing for all seats approved for occupancy during takeoff and landing.

The intent of Amendment 25-64 is to provide an improved level of safety for occupants on transport category airplanes. Because most seating is forward-facing on transport category airplanes, the pass/fail criteria developed in Amendment 25-64 focused primarily on these seats. Since Amendment 25-64, several airplanes with both forward-facing and aft-facing seats have been certificated using the criteria in Amendment 25-64, and one airplane with single-place side-facing seats has been certificated using equivalent criteria defined in an issue paper.

For multiple occupancy seating, the best criteria currently available cannot be said to provide an equivalent level of safety for those occupants. Therefore, the only vehicle available for accepting these installations will be through an exemption from the general injury requirements of § 25.785(b). The criteria contained in this issue paper may be included in a petition for exemption from the noted requirement if an applicant so chooses. Any petition for exemption must also address why a grant of the petition would be in the public interest, in accordance with § 11.25(b)(5), and it should be emphasized that this public interest requirement must be satisfied regardless of the criteria that the divan is tested to.

FAA POSITION: The following proposed injury criteria and installation/testing guidelines represent the minimum acceptable standard for incorporation in a petition for exemption from the general occupant injury criteria of §25.785(b).

1. The Proposed Injury Criteria

(a) Existing Criteria: All injury protection criteria of § 25.562(c)(1) through (c)(6) apply to the occupants of side facing seating. HIC assessments are only required for head contact with the seat and/or adjacent structures.

(b) Body-to body contact: Contact between the head, pelvis, or shoulder area of one Anthropomorphic Test Dummy (ATD) on the adjacent seated ATD's is not allowed during the tests conducted in accordance with § 25.562(b)(1) and (b)(2). Incidental contact of the leg, feet, arms and hand that will not result in incapacitation of the occupants is acceptable. Contact during rebound is allowed.

(c) Body-to-wall/furnishing contact: If the sofa is installed aft of a structure such as an interior wall or furnishing that may contact the pelvis, upper arm, chest, or head of an occupant seated next to the structure, a conservative representation of the structure and its stiffness must be included in the tests. The contact surface of this structure must be covered with at least two inches of energy absorbing protective foam, such as ensolite.

(d) Thoracic Trauma: Testing with a Side Impact Dummy (SID), as defined by 49 CFR Part 572, Subpart F, or its equivalent, must be conducted and Thoracic Trauma Index (TTI) injury criteria acquired with the SID must be less than 85, as defined in 49 CFR Part 572, Subpart F. SID TTI data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS) Part 571.214, section S6.13.5.

(e) Pelvis: Pelvic lateral acceleration must not exceed 130g. Pelvic acceleration data must be processed as defined in FMVSS Part 571.214, section S6.13.5.

(f) Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for sofa occupants, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

2. General Guidelines

(a) All side facing seats require end closures.

(b) All seat positions need to be occupied for the longitudinal tests.

(c) For the longitudinal tests, conducted in accordance with the conditions specified in § 25.562(b)(2), a minimum of two tests will be required, as follows:

(1) One test will be required with one SID ATD in the forward most position and Hybrid II ATD(s) in all other positions, with undeformed floor, no yaw, and with all lateral supports (armrests/walls).

(2) One test will be required with one SID ATD in the center seat and Hybrid II ATD(s) in all other positions, with deformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). This could be considered the structural test as well.

(d) For the vertical test, conducted in accordance with the conditions specified in § 25.562(b)(1), Hybrid II ATD's will be used in all seat positions.

FCAA POSITION:

Open.

APPLICANT'S POSITION:

Open.

CONCLUSION:

Open.

ISSUE PAPER

PROJECT: Generic

ITEM: CI-X
STAGE: 1

REG. REF.: §§21.16, 25.562, 25.785

DATE: Nov. 12, 1997

NATIONAL POLICY REF.:

ISSUE STATUS: OPEN

SUBJECT: Dynamic Test Requirements for Single Place Side-Facing Seats

BRANCH ACTION: ANM-112, AAM-630, ANM-102N

Please read 11/19/97 memo
Based on GIP # C-x2

COMPLIANCE TARGET: Pre-TC

PROPOSED SPECIAL CONDITION

STATEMENT OF ISSUE: Side Facing seats are considered a novel design for Transport Category Airplanes that include amendment 25-64 in the certification basis, and were not considered when those airworthiness standards were promulgated. The FAA has determined that the existing regulations do not provide adequate or appropriate safety standards for occupants of side-facing single occupant seats (divans). In order to provide a level of safety that is equivalent to that afforded to occupants of forward and aft facing seating, additional airworthiness standards, in the form of special conditions, are necessary.

This issue paper will be used to establish the minimum acceptable testing and human injury criteria that will be applied to single occupancy, side-facing seat certifications. This information will complement the criteria given in § 25.562 of the Federal Aviation Regulations (FAR), and can be used in developing Special Conditions in accordance with § 21.16 of the FAR.

BACKGROUND: Part 25 of the FAR was amended June 16, 1988, by Amendment 25-64, to revise the emergency landing conditions that must be considered in the design of the airplane. Amendment. 25-64 revised the static load conditions in § 25.561, and added a new § 25.562 that required dynamic testing for all seats approved for occupancy during takeoff and landing. The intent of Amendment 25-64 is to provide an improved level of safety for occupants on transport category airplanes. Because most seating is forward-facing on transport category airplanes, the pass/fail criteria developed in Amendment 25-64 focused primarily on these seats. Since adoption of Amendment 25-64, several airplanes with both

forward-facing and aft-facing seats have been certificated using the criteria in Amendment 25-64, and two airplanes with single-place side-facing seats have been certificated using equivalent criteria defined in an issue paper.

The criteria applied to each certification was somewhat different, although the approaches were quite similar. This issue paper is intended to provide a standardized methodology to address all such approvals in the future. Since the regulations do not address side-facing seats, these criteria should be documented in Special Conditions.

FAA POSITION: In addition to the airworthiness standards in §§ 25.562 and 25.785, the following proposed special condition provides injury criteria and installation/testing guidelines represent the minimum acceptable airworthiness standard for side facing seats:

1. The Proposed Injury Criteria

(a) Existing Criteria: All injury protection criteria of § 25.562(c)(1) through (c)(6) apply to the occupant of a side facing seat. HIC assessments are only required for head contact with the seat and/or adjacent structures.

(b) Body-to-wall/furnishing contact: The seat must be installed aft of a structure such as an interior wall or furnishing that will support the pelviI ws, upper arm, chest, and head of an occupant seated next to the structure. A conservative representation of the structure and its stiffness must be included in the tests. The contact surface of this structure must be covered with at least two inches of energy absorbing protective foam, such as ensolite.

(c) Thoracic Trauma: Testing with a Side Impact Dummy (SID), as defined by 49 CFR Part 572, Subpart F, or its equivalent, must be conducted and Thoracic Trauma Index (TTI) injury criteria acquired with the SID must be less than 85, as defined in 49 CFR Part 572, Subpart F. SID TTI data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS) Part 571.214, section S6.13.5. Rational analysis, comparing an installation with another installation where TTI data were acquired and found acceptable, may also be viable.

(d) Pelvis: Pelvic lateral acceleration must not exceed 130g. Pelvic acceleration data must be processed as defined in FMVSS Part 571.214, section S6.13.5.

(e) Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for occupants, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

2. General Test Guidelines

(a) One test with the SID ATD, undeformed floor, no yaw, and with all lateral structural supports (armrests/walls).

Pass/fail injury assessments: TTI; and pelvic acceleration.

(b) One test with the Hybrid II ATD, deformed floor, with 10 degrees yaw, and with all lateral structural supports (armrests/walls).

Pass/fail injury assessments: HIC; and upper torso restraint load, restraint system retention and pelvic acceleration.

(c) Vertical (14 G's) test to be conducted with modified Hybrid II ATDs with existing pass/fail criteria.

FCAA POSITION:

Open.

APPLICANT'S POSITION:

Open.

CONCLUSION:

Open.